An ontology for mammography screening recommendation

Cindy Acuña, Yasmine Anchén, Edelweis Rohrer, Regina Motz

Facultad de Ingeniería and Facultad de Medicina, Universidad de la República, Uruguay.

August, 2023.
Content

• Motivation

• Related work

• Mammography screening recommendation ontology

• Work in progress

• Conclusions and future work
Motivating scenario: breast cancer prevention

Breast Cancer Screening for Women at Average Risk
2015 Guideline Update From the American Cancer Society

Kevin C. Oeffinger, MD, Elizabeth T. H. Fontham, MPH, DrPH, Ruth Etzioni, PhD, Abbe Herzog, PhD; James S. Michaelson, PhD; Ya Chen Tina Shih, PhD; Louise C. Walter, MD, Timothy R. Church, PhD; Christopher R. Flowers, MD, MS; Samuel J. LaMonte, MD; Andrew M. D. Wolf, MD; Carol DeSantis, MPH; Joanne Lortet-Tieulent, MSc; Kimberly Andrews; Deana Maruani-Baptiste, PhD; Debbie Saslow, PhD; Robert A. Smith, PhD; Otis W. Brawley, MD; Richard Wender, MD.
The ACS guideline recommendations

American Cancer Society
Breast Cancer Screening Guide for Women at Average Risk 2018

Women at average risk of breast cancer

- No history of prior radiation therapy to the chest at a young age (10 to 30 years)
- No personal history of breast cancer
- No suspected or confirmed genetic mutation known to increase breast cancer risk

40-44 years

Study to be carried out: screening mammography

Periodicity: Annual

Strong recommendation: Consensus that the benefits of adherence to this intervention outweigh the undesirable effects that may result from screening.

45-54 years

Study to be carried out: screening mammography

Periodicity: Annual

Qualified recommendation: They indicate that there is clear evidence of benefit from screening, but less certainty about the balance of benefits and harms.

>55 years

Study to be carried out: screening mammography

Periodicity: Annual

Periodicity: Biennial

Strong recommendation: Consensus that the benefits of adherence to this intervention outweigh the undesirable effects that may result from screening.
Related work


Mammography screening recommendation ontology
### Women classification

With intermediate risk ≡ Woman □
∃doesNotHaveHistory.{Confirmed or suspected genetic mutation} □
∃doesNotHaveHistory.{Personal history of breast cancer} □
∃doesNotHaveHistory.{Radiotherapy to the chest}
Age Range 40 to 44 ≡ With intermediate risk □ ∃age. ≥ 40 □ ∃age. ≤ 44
Age Range 45 to 54 ≡ With intermediate risk □ ∃age. ≥ 45 □ ∃age. ≤ 54
Age gt or eq 55 ≡ With intermediate risk □ ∃age. ≥ 55

### Recommendation

Age Range 40 to 44 ⊑ ∃hasRecommendation.{40 to 44 Age range recommendation}
Age Range 45 to 54 ⊑ ∃hasRecommendation.{45 to 54 Age range recommendation}
Age gt or eq 55 ⊑ ∃hasRecommendation.{55 Age range recommendation}

hasRecommendation o hasRecType ⊑ isRecommended
hasRecommendation o hasMammography ⊑ isRecommended
hasRecommendation o hasPeriodicity ⊑ isRecommended
Ontology restrictions: entailing recommendations

**Women classification**

With intermediate risk ≡ Woman
∃doesNotHaveHistory.{Confirmed or suspected genetic mutation}
∃doesNotHaveHistory.{Personal history of breast cancer}
∃doesNotHaveHistory.{Radiotherapy to the chest}

Age Range 40 to 44 ≡ With intermediate risk ∩ ∃age. ≥ 40 ∩ ∃age. ≤ 44
Age Range 45 to 54 ≡ With intermediate risk ∩ ∃age. ≥ 45 ∩ ∃age. ≤ 54
Age gt or eq 55 ≡ With intermediate risk ∩ ∃age. ≥ 55

**Recommendation**

Age Range 40 to 44 ⊑ ∃hasRecommendation.{40 to 44 Age range recommendation}
Age Range 45 to 54 ⊑ ∃hasRecommendation.{45 to 54 Age range recommendation}
Age gt or eq 55 ⊑ ∃hasRecommendation.{55 Age range recommendation}

hasRecommendation o hasRecType ⊑ isRecommended
hasRecommendation o hasMammography ⊑ isRecommended
hasRecommendation o hasPeriodicity ⊑ isRecommended
Inference of direct recommendations

**Recommendation**
- 45 to 54 Age range recommendation
- >= 55 Age range recommendation

**Recommendation Type**
- Qualified
- Strong

**Mammography**
- Screening Mammography

**Periodicity**
- Annual
- Annual or Biannual

**Woman**
- With intermediate risk
  - Age Range 40 to 44
    - Woman 1
  - Age Range 45 to 54
    - Woman 2
    - Woman 3
    - Woman 6
  - Age gt or eq 55
    - Woman 4

**History**
- Personal Medical History
  - Confirmed or suspected genetic mutation
  - Personal history of breast cancer
  - Radiotherapy to the chest

**Various**
- doesNotHasHistory
- hasRecommendation
- hasRecType
- hasPeriodicity
- hasMammography
Implementation of recommendations
Work in progress: different models and guidelines

different guidelines: ACS, Canadian, Uruguayan... for different risk levels

extension for high risk of contracting the disease evaluated by different models: Claus, Tyrer/Cuzick that use different risk factors
Extended ontology for different models and guidelines
Conclusions

The Mammography screening ontology provides personalized recommendations for the early detection of breast cancer in women at average risk of the disease

- based on the age range defines the strength and frequency of the screening mammography
- promising tool for doctor-patient communication and training of preservice health professionals
- allows medical professionals quick access to guideline recommendations in a non-verbose presentation
- simple design, allowing its extension and reuse
Future work

• Validation of the extended ontology that entails recommendations for different risk levels evaluated by different models (work in progress)

• Validation of a framework that uses the extended ontology, by medical professionals of different health institutions

• Extension of the solution to other types of cancer and other diseases
Thank you!

yasanmo@gmail.com, erohrer@fing.edu.uy